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Data Assessment Reports for CEMS (Continuous Emission Monitoring Systems) at Subpart Da Facilities

Entropy Environmentalists, Inc.
Research Triangle Park, NC

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

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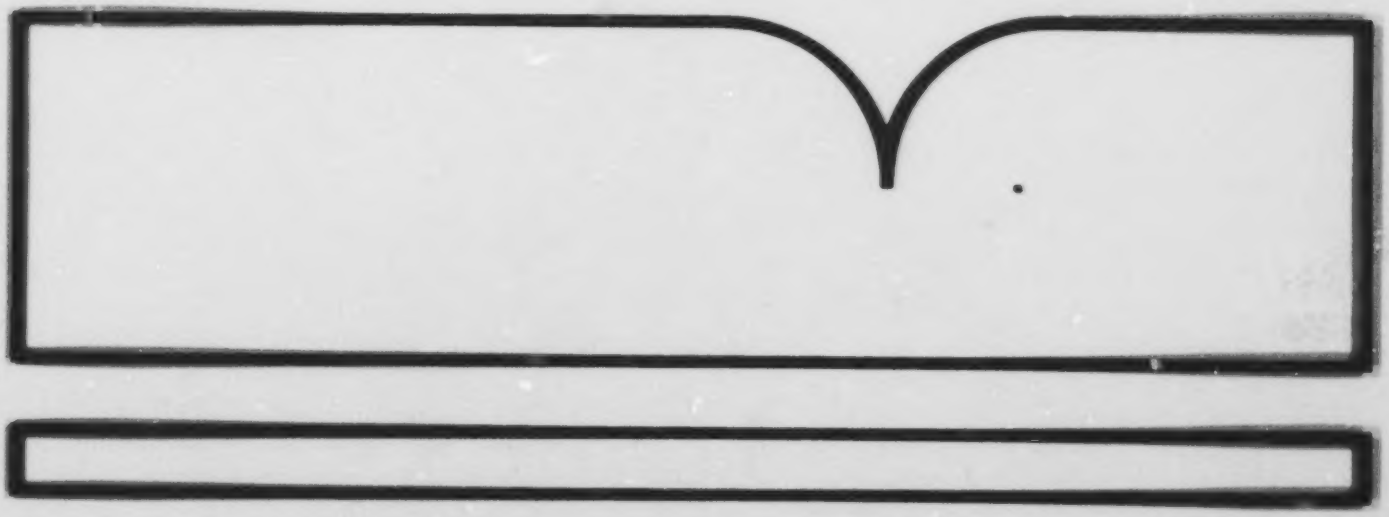

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DATA ASSESSMENT REPORTS FOR CEMS AT SUBPART Da FACILITIES

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16. ABSTRACT

EPA promulgated minimum quality assurance (QA) requirements for Continuous Emission Monitoring Systems (CEMS) in 40 CFR Part 60 Appendix F. Appendix F requires Da source owners to develop site-specific QA plans and report the results of EPA specified QA activities each calendar quarter. The first calendar quarter for which a report was to be submitted is January through March 1988.

The report of QA activities under Appendix F is called a Data Assessment Report (DAR). The DAR includes identifying and descriptive information for the CEMS, results of periodic audits, identification of periods when calibration drift exceeds specified criteria, identification of periods when the analyzers or CEMS are out of control (OOC), and descriptions of corrective actions in response to OOC conditions. An OOC period occurs when an analyzer or a CEMS fails to meet criteria specified in Appendix F. The criteria are expressed in terms of CEMS relative accuracy, analyzer accuracy, and analyzer drift.

The principle objective of this study is an evaluation of the information in DARs for the first and second quarters of calendar year 1988. Secondary study objectives include (1) the establishment of contacts with agency staff who normally receive the DARs each quarter and (2) identification of facilities for which DARs were apparently not received, for follow-up by the appropriate agency.

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ABSTRACT

This report is a summary of the information provided in Data Assessment Reports for the first two quarters of calendar year 1988. The reports were submitted to enforcement agencies by owners or operators of Subpart Da Electric Steam Generating units in response to the requirements of 40 CFR Part 60 Appendix F. Appendix F establishes minimum quality assurance requirements for continuous emission monitoring systems when used as the New Source Performance Standard performance test method.

Data on Relative Accuracy Test Audits were obtained for 24 facilities. Fifty three Relative Accuracy Test Audits were done for SO_2; 31 audits were done for NO_x. Eight continuous emission monitoring systems at six facilities exceeded the criteria of 20 percent relative accuracy for acceptable performance. In three cases the audits were repeated and relative accuracy was demonstrated to be less than 20 percent. In the remaining cases the boilers were taken out-of-service for maintenance. No periods of invalid data were reported because of excessive inaccuracy based on Relative Accuracy Test Audits. A comparison of audit results with data from a prior study suggests an improved distribution of Relative Accuracy values for the Da monitoring systems.

Data for Cylinder Gas Audits were obtained for SO_2, NO_x, CO_2, and O_2 analyzers at 19 facilities. With the exception of one audit, all analyzers were demonstrated to be operating within the specified plus or minus 15 percent accuracy. Approximately 60 percent of the results were within plus or minus three percent accuracy. No periods of invalid data were reported because of excessive inaccuracy based on Cylinder Gas Audits.

Almost 50 percent of the Data Assessment Reports contained no information on Calibration Drift Assessment. Nine Data Assessment Reports indicated no excessive calibration drift. Fourteen reports included days on which one or more analyzers were found to exceed Appendix F criteria for excessive drift. In all cases the criterion exceeded was for one day's operation. In almost all cases, periods of invalid data because of excessive drift were incorrectly reported in fractions of a day.

Corrective actions for excessive drift were noted in the 14 Data Assessment Reports which included information on excessive drift. A majority of the corrective actions appear to be items that should be performed routinely in response to the facilities quality control plan.

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SECTION 1

BACKGROUND

The U.S. Environmental Protection Agency (EPA) promulgated a New Source Performance Standards (NSPS) for Electric Utility Steam Generating Units under 40 CFR Part 60 Subpart Da in June 1979. Subpart Da applies to units for which construction was commenced after September 18, 1978. For convenience, the term "Da" is used in this report as a short-hand for "Subpart Da."

The Da emission standards for sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are based on an average emission rate for 30 consecutive boiler operating days; a new 30-day performance test is completed at the end of each boiler operating day. A day is defined as a 24 hour period from midnight to midnight. A boiler operating day is defined as a day during which fuel is burned for the entire 24 hours. The NSPS requires the use of continuous emission monitoring systems (CEMS) as the performance test method.

The EPA promulgated minimum quality assurance (QA) requirements, to be implemented by the source owner when the CEMS is specified as the performance test method. The QA requirements were published in 40 CFR Part 60 Appendix F and became effective in December, 1987. Appendix F requires Da source owners to develop site-specific QC plans and to report the results of EPA specified QA activities each calendar quarter. The first calendar quarter for which a report was to be submitted is January through March, 1988.

The report of QA activities under Appendix F is called a Data Assessment Report (DAR). The DAR includes identifying and descriptive information for the CEMS, results of quarterly audits, identification of periods when calibration drift exceeds specified criteria, identification of periods when the analyzers or CEMS are out-of-control (OOC), and descriptions of corrective actions in response to OOC conditions. An OOC period occurs when an analyzer or a CEMS fails to meet criteria specified in Appendix F. The criteria are expressed in terms of CEMS relative accuracy, analyzer accuracy, and analyzer drift.

Data generated by a CEMS after the CEMS is found to be OOC can not be used to meet the minimum number of measurements that are required in Da to calculate 30-day averages. If minimum data needs are not met with the CEMS, supplemental sampling is required.

Appendix F requires an audit of each CEMS each calendar quarter. Audit results are summarized in Sections 4, 5, and 6 of this report. The names of the audits are:

- o Relative Accuracy Test Audit (RATA).
- o Cylinder Gas Audit (CGA).
- o Relative Accuracy Audit (RAA).

The NSPS General Provisions (Subpart A) and Appendix F require a daily assessment of drift. In Appendix F the daily check is called a Calibration Drift Assessment (CDA). Information relating to CDA is discussed in Section 7 of this report.

SECTION 2

STUDY OBJECTIVES AND PURPOSE OF REPORT

PRINCIPAL OBJECTIVE

The principle objective of this study is an evaluation of the information in DARs for the first and second quarters of calendar year 1988. Results of this evaluation will provide:

- o A basis for planning revisions or modifications to Appendix F.
- o Comparative statistics on CEMS performance for use by enforcement agencies in evaluating specific results.
- o The beginnings of a data base for judging trends in CEMS performance with time.

SECONDARY OBJECTIVES

Secondary study objectives include:

- o The establishment of contacts with agency staff who normally receive the DARs each quarter.
- o Identification of facilities for which DARs were apparently not received, for follow-up by the appropriate agency.

PURPOSES

The purpose of this report is to provide a summary of the information in the DARs for EPA Regional Office, State, and local agency staff. In addition, this report will be sent to Da sources:

- o As an aid in their preparation of future DARs.
- o As resource information for their future selection of CEMS.

SECTION 3

OVERVIEW OF INFORMATION OBTAINED

Da FACILITIES

Thirty seven facilities operated by 28 companies were identified as operating Da units at the start of this study.[1] The units are listed in Table 1. For convenience, each unit is assigned an identifying code number, which is also shown in Table 1. The first character in the code identifies the EPA Regional Office responsible for enforcement of the NSPS; the second and third characters are standard two-letter abbreviations for the State where the source is located. The number following the state abbreviation consists of two parts: a consecutive number for each company operating a Da unit within a State, which preceeds the decimal; and, a consecutive number for each Da facility operated in the State by the company, which follows the decimal.

CONTACT PERSONS

Table 2 is a list of persons who supplied copies of the DARs, along with their phone numbers and agency affiliations. Agency affiliations are EPA Regional Offices, State agency headquarters, State agency district offices, and county agencies.

MISSING DATA

Information is not reported for ten Da units. Explanations for the missing data are:

4FL02.1 - A contact person for this unit was not located until mid-September. By this time further entries in the data base would have interferred with efficient sorting and analysis of available data. Follow-up was postponed pending completion of this report.

5MI05.1 - According to the contact person, the company operating this facility was under a consent decree with EPA and the State, and was completing the installation of new CEMS.

6OK02.1 - Copies of the DARs were not received from the contact person by mid-September. It is not known if DARs were submitted by the source owner. Follow-up was postponed pending completion of this report.

8UT06.1 - According to the contact person, DARs were not received by the State agency.

9CA01.1 - Copies of the DARs were not received from the contact person by mid-September. It is not known if DARs were submitted by the source owner.

TABLE 1. LIST OF SUBPART Da FACILITIES

Unit Code	Utility	Facility
2NY01.1	NY State Electric & Gas	Somerset #1
4FL01.1	Jacksonville Electric Authority	Pwr Park #1
4FL02.1	Orlando Utility Commission	Stanton #1
4FL03.1	Seminole Electric Cooperative	Palatka #1
4FL03.2	Seminole Electric Cooperative	Palatka #2
4FL04.1	Tampa Electric Company	Big Bend #4
4KY05.1	Big Rivers Electric Cooperative	DB Wilson #1
4SC06.1	SC Public Service Authority	Cross #2
5IN01.1	Northern Indiana Public Service	Schahfer #17
5IN01.2	Northern Indiana Public Service	Schahfer #18
5IN02.1	Southern Indiana Gas & Electric Co	AB Brown #2
5MI03.1	Grand Haven Board of Light & Power	JB Sims #3
5MI04.1	Michigan South Central Power	Mich Proj #1
5MI05.1	Marquette Board of Light & Power	Shiras #3
5MN06.1	Northern States Power	Sherco #3
6NM01.1	Plains Electric Generation & Transmission	Plains #1
6OK02.1	Grand River Dam Authority	GRDA #2
6TX03.1	Houston Lighting & Power Co	Limestone #1
6TX03.2	Houston Lighting & Power Co	Limestone #2
6TX03.3	Houston Lighting & Power Co	WA Parrish #8
6TX04.1	West Texas Utilities Company	Oklaunion #1
7IA01.1	Muscatine Power & Water	Muscatine #9
7KS02.1	Sunflower Electric Cooperative	Holcomb #1
8CO01.1	Colorado Ute Electric Association	Craig #3
8CO02.1	Platte River Electric Authority	Rawhide #1
8ND03.1	United Power Association	Stanton #10
8UT04.1	Deseret Generation & Transmission Coop	Bonanza #1
8UT05.1	Intermountain Power Service Corporation	IGS #1
8UT05.2	Intermountain Power Service Corporation	IGS #2
8UT06.1	Utah Power and Light Company	Hunter #3
9CA01.1	Corn Products	Stockton
9CA02.1	Luz Engineering Corporation	SEGS II
9CA02.2	Luz Engineering Corporation	SEGS III
9CA02.3	Luz Engineering Corporation	SEGS IV
9CA02.4	Luz Engineering Corporation	SEGS V
9NV03.1	Nevada Power Company	R Gardner #4
9NOV4.1	Sierra Pacific Power Company	North Valmy #2

TABLE 2. LIST OF AGENCY CONTACT PERSONS

Unit Code	Contact Person	Agency	Phone
2NY01.1	Ann Zownir	EPA RO 2	(201) 321-6699
4FL01.1	Mort Benjamin	State DO	(904) 798-4200
4FL02.1	Dennis Nestor	County	(407) 244-7400
4FL03.1	Mort Benjamin	State DO	(904) 798-4200
4FL03.2	Mort Benjamin	State DO	(904) 798-4200
4FL04.1	William Schroeder	State DO	(813) 272-5530
4KY05.1	Steve Hagedorn	State Hdq	(502) 564-3382
4SC06.1	Jake Frick	State Hdq	(803) 734-4750
5IN01.1	Rod Thompson	State Hdq	(317) 243-5125
5IN01.2	Rod Thompson	State Hdq	(317) 243-5125
5IN02.1	Rod Thompson	State Hdq	(317) 243-5125
5MI03.1	Joe Holms	State DO	(616) 456-5071
5MI04.1	Patric McCoy	EPA RA #5	(312) 886-6869
5MI05.1	Don Stephens	State DO	(906) 228-6561
5MN06.1	Lori Bartel	State Hdq	(612) 296-7599
6NM01.1	Stanley Spruiell	EPA RO #6	(214) 655-7229
6OK02.1	Stanley Spruiell	EPA RO #6	(214) 655-7229
6TX03.1	Stanley Spruiell	EPA RO #6	(214) 655-7229
6TX03.2	Stanley Spruiell	EPA RO #6	(214) 655-7229
6TX03.3	Stanley Spruiell	EPA RO #6	(214) 655-7229
6TX04.1	Stanley Spruiell	EPA RO #6	(214) 655-7229
7IA01.1	Dave Phelps	State Hdq	(515) 281-8189
7KS02.1	Jon Knodel	EPA RO #7	(913) 296-2896
8CO01.1	Robert Jorgenson	State Hdq	(303) 331-8580
8CO02.1	Robert Jorgenson	State Hdq	(303) 331-8580
8ND03.1	Gary Helbling	State Hdq	(701) 224-2348
8UT04.1	Norm Erickson	State Hdq	(801) 538-6108
8UT05.1	Norm Erickson	State Hdq	(801) 538-6108
8UT05.2	Norm Erickson	State Hdq	(801) 538-6108
8UT06.1	Norm Erickson	State Hdq	(801) 538-6108
9CA01.1	Chuck Seeley	EPA RO #9	(415) 974-7648
9CA02.1	Chuck Seeley	EPA RO #9	(415) 974-7648
9CA02.2	Chuck Seeley	EPA RO #9	(415) 974-7648
9CA02.3	Chuck Seeley	EPA RO #9	(415) 974-7648
9CA02.4	Chuck Seeley	EPA RO #9	(415) 974-7648
9NV03.1	Tom Porta	State Hdq	(702) 885-5065
9NV04.1	Tom Porta	State Hdq	(702) 885-5065

9CA02.1 through 9CA02.4 - According to the contact person, the company operating these four Da units is under a consent decree to install CEMS.

9NV04.1 - A copy of the DAR for the third quarter of calendar year 1988 was received in December 1988. This is apparently the first DAR submitted by the source.

INFORMATION RECEIVED

A generic tabulation of audit information obtained is provided in Table 3. A review of the information in Table 3 shows that:

- Several facilities performed a CGA in the first, and a RATA in the second quarter, despite the requirement in Appendix F to do a RATA in the first quarter. In one case (5MN06.1) a CGA was done for both quarters. In another case (8ND03.1) the initial RATA was done in the fourth quarter of 1987.

- Almost 50 percent of the DARs contained no information on the required CDA, or periods when the CEMS were defined as OOC because the CD criteria in Appendix F were not met. Except for two cases (5IN02.1 & 9NV03.1), corrective actions were noted when OOC periods were identified.

- A RAA was reported by one facility, 4KY05.1.

CEM INFORMATION

A list of manufacturers, analyzer model numbers, and CEMS type, as reported in the DARs, is provided in Table 4. In some cases, reported information in Table 4 is contradicting; in other cases, it is in error. For purposes of this project, the information is presented as reported.

TABLE 3. SUMMARY OF DAR INFORMATION

Unit Code	Audit Type Qtr 1	Audit Type Qtr 2	CDA OOC Periods Qtr 1	CDA OOC Periods Qtr 2	Corrective Actions
2NY01.1	RATA	CGA	No	No	
4FL01.1	RATA	CGA	Yes	Yes	Yes
4FL02.1					
4FL03.1	RATA	CGA	Yes	No	Yes
4FL03.2	RATA	CGA	Yes	Yes	Yes
4FL04.1	RATA	CGA	Yes	NR*	Yes
4KY05.1	RATA	RAA	No	No	
4SC06.1	RATA	CGA	NR	NR	
5IN01.1	CGA		NR		
5IN01.2	CGA		NR		
5IN02.1	RATA		Yes		NR
5MI03.1		RATA		NR	
5MI04.1	RATA		NR		
5MI05.1					
5MN06.1	CGA	CGA	NR	NR	
6NM01.1		RATA		Yes	Yes
60K02.1					
6TX03.1	RATA	CGA	Yes	NR	Yes
6TX03.2	RATA	CGA	Yes	NR	Yes
6TX03.3	RATA	CGA	NR	NR	
6TX04.1	RATA		Yes		Yes
7IA01.1	RATA	CGA	No	Yes	Yes
7KS02.1	RATA	CGA	NR	Yes	Yes
8CO01.1	RATA	CGA	No	No	
8CO02.1	RATA	CGA	No	NR	
8ND03.1	RATA	CGA	NR	Yes	Yes
8UT04.1	CGA	RATA	NR	NR	
8UT05.1		RATA		NR	
8UT05.2	CGA	RATA	NR	NR	
8UT06.1					
9CA01.1					
9CA02.1					
9CA02.2					
9CA02.3					
9CA02.4					
9NV03.1	RATA		Yes		NR
9NV04.1					

*NR = Not reported.

TABLE 4. CEMS MANUFACTURERS, MODEL NUMBERS AND TYPES

Manufacturer	Unit	Gas	Model	Type
Automated Custom Systems	6TX03.1	CO2	Fuji 3300	Extractive
	6TX03.2	CO2	Fuji 3300	Extractive
	6TX03.3	CO2	Fuji 3300	Extractive
Contravez Goerz	4KY05.1	SO2	GEM100	Cross-stack
	4KY05.1	NOx	GEM100	Cross-stack
Dupont	5MI03.1	SO2	460	Extractive
	4FL04.1	NOx	461	Extractive
Foxboro	8UT05.2	02	NR*	Extractive
	8UT05.2	SO2	NR	Extractive
	8UT05.2	NOx	NR	Extractive
KVB	8UT04.1	NOx	NR	Extractive
	8UT04.1	SO2	NR	Extractive
Lear Seigler	5MN06.1	02	CM60	Extractive
	5MN06.1	CO2	EX4700	Extractive
	5MN06.1	SO2	SM8100	Extractive
	5MN06.1	NO	SM8100	Extractive
	4SC06.1	SO2	802-820-81	Extractive
	4SC06.1	02	802-820-81	Extractive
	4SC06.1	NOx	802-820-81	Extractive
	2NY01.1	SO2	CM50	In-Situ
	2NY01.1	02	CM50	In-Situ
	4FL03.1	02	CM50	In-Situ
	4FL03.2	02	CM50	In-Situ
	4FL04.1	02	CM50	In-Situ
	5MI03.1	02	CM50	Extractive
	2NY01.1	SO2	SM810	In-Situ
	2NY01.1	02	SM810	Extractive
	2NY01.1	NOx	SM810	In-Situ
	4FL03.1	NOx	SM810	Extractive
	4FL03.1	SO2	SM810	In-Situ
	4FL03.2	SO2	SM810	In-Situ
	4FL03.2	NOx	SM810	In-Situ
	4FL04.1	NOx	SM810	In-Situ
	4FL04.1	SO2	SM810	In-Situ
	5MI03.1	SO2	SM810	Extractive
	5MI03.1	NOx	SM810	In-Situ
	5MI04.1	NOx	SM810	Extractive
	5MI04.1	SO2	SM810	Extractive
	7KS02.1	SO2	SM810	In-Situ
	8ND03.1	SO2	SM8100	In-Situ
	8ND03.1	NOx	SM8100	In-Situ
	8ND03.1	02	SM8100	In-Situ

(continued)

TABLE 4. (continued)

Manufacturer	Unit	Gas	Model	Type
Thermo Environmental	6TX04.1	SO2	100	NR
	6TX04.1	NOx	100	NR
	4FL01.1	NOx	10AR	Extractive
	5IN02.1	NOx	10AR	Extractive
	6NM01.1	NOx	10AR	Extractive
	6TX03.1	NOx	10AR	Extractive
	6TX03.2	NOx	10AR	Extractive
	6TX03.3	NOx	10AR	Extractive
	7KS02.1	NOx	10AR	Extractive
	8C002.1	NO	200	Extractive with Dilution Probe
	8C002.1	SO2	200	Extractive with Dilution Probe
	8C002.1	CO2	200	Extractive with Dilution Probe
	8C002.1	NOx	200	Extractive with Dilution Probe
	5IN02.1	SO2	40	Extractive
Thermo Environmental - KVB	5IN01.1	NOx	10AR	Extractive
	5IN01.2	NOx	10AR	Extractive
	7IA01.1	NOx	10AR	Extractive
	9NV03.1	NOx	10AR	Extractive
Thermox	7KS02.1	O2	III	Extractive
	7KS02.1	SO2	III	Extractive
	4FL01.1	O2	WDGIII	Extractive
Thermox - KVB	5IN01.1	O2	III	Extractive
	5IN01.2	O2	III	Extractive
	9NV03.1	O2	NA	Extractive
	7IA01.1	O2	WDGIII	Extractive
Western Research	4FL01.1	SO2	721A	Extractive
	6TX03.1	SO2	721A	Extractive
	6TX03.2	SO2	721A	Extractive
	6TX03.3	SO2	721A	Extractive
	7KS02.1	SO2	721A	Extractive
	6NM01.1	SO2	721/721A	Extractive
Western Research - KVB	5IN01.1	SO2	10AR-721	Extractive
	5IN01.1	SO2	721	Extractive
	5IN01.2	SO2	721	Extractive
	9NV03.1	SO2	721	Extractive
	7IA01.1	SO2	721A	Extractive

(continued)

TABLE 4. (continued)

Manufacturer	Unit	Gas	Model	Type
Westinghouse	7KS02.1	02	218	Extractive
	6TX04.1	SO2	EC960	NA
Manufacturer Not Listed in DAR	8C001.1	SO2	NR	In-Situ w/ Dilution Probe
	8C001.1	CO2	NR	In-Situ w/ Dilution Probe
	8C001.1	NO	NR	In-Situ w/ Dilution Probe
	8UT04.1	NOx	NR	Extractive
	8UT04.1	SO2	NR	Extractive
	8UT04.1	02	NR	Extractive
	8UT05.1	NOx	NR	Extractive
	8UT05.1	SO2	NR	Extractive
	8UT05.1	02	NR	Extractive
	8UT05.2	NOx	NR	Extractive
	8UT05.2	SO2	NR	Extractive

*NR - Not reported in DAR.

SECTION 4

RELATIVE ACCURACY TEST AUDITS

GENERAL INFORMATION

Appendix F requires a minimum of one RATA for each Da facility every calendar year. A RATA was supposed to be done in the first quarter of 1988 for units in operation on the effective date of Appendix F. A RATA is patterned after the Performance Specification Test (PST) required for each CEMS at the time of installation. It consists of a comparison of CEMS response with at least nine measurements using EPA test methods. The result of the RATA is the CEMS Relative Accuracy (RA). The RA is expressed as a percentage of the mean of the test method measurements and consists of two components: The absolute difference between the CEMS response and test method measurements; and, a confidence coefficient. All data are to be in units of the applicable standard.

Data on RATAs were obtained for 24 Da facilities. A tabulation of selected information pertaining to this data base is provided in Table 5. A review of the information in Table 5 shows that:

- Seven facilities monitor SO_2 at two inlet locations.
- Three facilities monitor NO_x at an inlet and outlet location.
- Six facilities performed RATAs for diluent gases.
- The number of analyzers at a facility ranges from one to six; eight facilities use two and six facilities use three analyzers.
- The RATAs were performed during the second quarter of 1988 at five facilities.
- At unit 6TX03.2 an NO_x RATA was done in the first quarter and twice on a different analyzer in the second quarter. Interestingly, the serial number for the analyzer tested in the second quarter is the same as the serial number for an analyzer at 6TX03.1.

RELATIVE ACCURACY OF SO_2 CEMS

Table 6 is a compilation of data for 53 SO_2 RATAs. The basis for comparison is EPA M6 for 30 tests, and EPA M6C for 15 tests. Three facilities did not report the basis for comparison. Two facilities calculated the RA based on concentration units; three facilities did not report the CEMS or test method data.

TABLE 5. SELECTED INFORMATION ON RATA CONDUCTED AT Da FACILITITES

Unit	Qtr	I/O*	Gas	EPA Method	% RA	Serial No.	No. of Analyzers
2NY01.1	1	I	SO2	M6C	3	102662U	3
		I	SO2	M6C	5	102663U	
		O	SO2	M6C	12.1	113742V	
		O	NOx	M7E	13.6	113742V	
4FL01.1	1	I	SO2	M6C	0.9	6709-6	2
		O	SO2	M6C	5.8	6709-6	
		O	NOx	M7E	4.3	15200-349	
4FL03.1	1	I	SO2	M6	14.3	062641U	3
		I	SO2	M6	9.2	062640U	
		O	SO2	M6	12.8	062639V	
		O	NOx	M7E	8.1	062639V	
4FL03.2	1	I	SO2	M6	13.1	033693U	2
		O	SO2	M6	18	033695V	
		O	NOx	M7E	9.7	033695V	
4FL04.1	1	I	SO2	M6C	5.8	073722U	2
		O	SO2	M6C	7.9	073723U	
		I	NOx	M7E	8.6	073723V	
		O	NOx	M7E	3.5	073723V	
4KY05.1	1	I	SO2	M6C	4	1122	3
		I	SO2	M6C	10	1121	
		O	SO2	M6C	13	1123	
		O	NOx	M7E	16	1123	
4SC06.1	1	I	SO2	M6	4.55	R01757	2
		O	SO2	M6	6.32	R01757	
		O	NOx	M7	7.74	S06889	
5IN02.1	1	I	SO2	M6	5.41	18233-177	3
		I	SO2	M6	1.86	18233-177	
		O	SO2	M6	7.43	18192-177	
		O	NOx	M7	10.12	18138-176	
5MI03.1	2	I	SO2	M6C	13.2	5882	3
		O	SO2	M6C	9	062647V	
		O	O2	M3A	2.8	062890	
		O	NOx	M7E	7.1	062647V	
5MI04.1	1	I	SO2		11.4	121615V	1
		O	SO2		32.9	121615V	
		O	NOx		30.2	121615V	

(continued)

TABLE 5. (continued)

Unit	Qtr	I/O*	Gas	EPA Method	% RA	Serial No.	No. of Analyzers
6NM01.1	2	I	SO2	M6	7.56	82-721A-6541-5	2
		I	SO2	M6	10.97	82-721A-6541-5	
		O	SO2	M6	16.54	82-721A-6541-5	
		O	NOx	M7	9.58	KVB #15200	
6TX03.1	1	I	SO2	M6	16.5	84-721A-6286-1	2
		O	SO2	M6	15.7	84-721A-6286-1	
		O	NOx	M7E	24.8[1]	10A/R-1 7080-167	
		O	NOx	M7E	19.6[2]	10A/R-1 7080-167	
6TX03.2	1	I	SO2	M6	5.5	85-721A-6709-5	3
		O	SO2	M6	5	85-721A-6709-5	
		O	NOx	M7E	20.6	180009/174	
	2	O	NOx	M7E	47.11[1]	10A/R-1 7080-167	
		O	NOx	M7E	4.15[2]	10A/R-1 7080-167	
6TX03.3	1	I	SO2	M6	7.9	6541-1	2
		O	SO2	M6	12.4	6541-1	
		O	NOx	M7E	6.6	13-601-139	
6TX04.1	1	I	SO2	M6	18.07	NR**	
		I	SO2	M6	34.78	NR	
		I	NOx	M7E	35.42	NR	
7IA01.1	1	I	SO2	M6C	5.2	85-721A-6713-2	2
		O	SO2	M6C	14.3	85-721A-6713-2	
		O	NOx	M7E	11.3	10AR-17799-173	
7KS02.1	1	I	SO2	M6	4.5	122680U	5
		O	SO2	M6	11.2	122681U	
		O	SO2	M6	16	122682U	
		O	SO2	M6	9.2	332-2-02-31	
		O	NOx	M7	8.7	13656-140	
8C001.1	1	I	SO2	M6	3.39	NR	
		I	SO2	M6	6.24	NR	
		O	SO2	M6	16.5	NR	
		O	NO	M7	7.54	NR	
8C002.1	1	I	SO2	M6	17.6	NR	
		O	SO2	M6	10.7	NR	
		O	NOx	M7	21.2	NR	
		I	CO2	M3	3.9	NR	
		O	CO2	M3	13.8	NR	

(continued)

TABLE 5. (continued)

Unit	Qtr	I/O*	Gas	EPA Method	% RA	Serial No.	No. of Analyzers
8ND03.1	-1***	0	SO2	M6	7.5	04610650	1
		0	O2	M3	14.7	04610650	
		0	NOx	M7A	23.2	04610650	
	1	0	O2	M3	12.8	04610650	
		0	NOx	M7A	2.9	04610650	
8UT04.1	2	0	SO2	M6	8.6	NR	
		0	NOx	M7	16.1	NR	
8UT05.1	2	I	SO2		6	86-721A-6245-3	6
		0	SO2		14.9	86-721A-6245-5	
		I	O2		8.9	C026344-1	
		0	O2		3.7	C026776-1	
		I	NOx		2.2	19309-183	
		0	NOx		3.5	16553-162	
8UT05.2	2	I	SO2		4.9	86-721A-6245-1	6
		0	SO2		15.2	86-721A-6245-2	
		I	O2		7.4	C026776-4	
		0	O2		4.1	C026776-3	
		I	NOx		8	19312-182	
		0	NOx		2.8	16514-162	
9NV03.1	1	0	SO2	M6C	8.1	81-721-6492-1	3
		0	O2	M3A	2.5	20-8050-332-8-02-31	
		0	NOx	M7E	3.1	10AR-1236-127-S	

[1] Initial RATA result.
[2] Retest result.

*I = inlet, O = outlet
**NR = not reported
***RATA performed in November 1987

TABLE 6. RELATIVE ACCURACY TEST AUDIT DATA FOR SO_2 CEMS

Unit	Qtr	Method	Relative Accuracy Test Audit Values RM	CEM	Diff	CC	RA
2NY01.1	1	M6C	4.19	4.1	0.09	0.036	3
			3.701	3.579	0.122	0.06	5
			0.541	0.511	0.03	0.036	12.1
4FL01.1	1	M6C	6.254	6.241	0.0132	0.0435	0.9
			0.542	0.563	0.0217	0.0096	5.8
4FL03.1	1	M6	4.59	4.07	0.52	0.13	14.3
			4.33	4.09	0.25	0.15	9.2
			0.748	0.67	0.078	0.018	12.8
4FL03.2	1	M6	4.35	3.92	0.43	0.14	13.1
			0.543	0.558	0.054	0.043	18
4FL04.1	1	M6C	4.99	5.214	0.224	0.0668	5.8
			0.275	0.336	0.06	0.0048	7.9
4KY05.1	1	M6C	6.792	6.538	0.254	0.035	4
			6.726	6.091	0.634	0.038	10
			0.679	0.611	0.068	0.018	13
4SC06.1	1	M6	1.61	1.65	0.0398	0.0334	4.55
			0.51	0.54	0.0242	0.00833	6.32
5IN02.1	1	M6	5.81	6.03	0.22333	0.0909	5.41
			5.809	5.839	0.03	0.0781	1.86
			0.26389	0.25489	0.009	0.0106	7.43
5MI03.1	2	M6C	1913.1	1740.2	-172.9	80.5	13.2
			0.4843	0.4627	-0.0216	0.0221	9
5MI04.1	1						11.4
							32.9
6NM01.1	2	M6	786.3	797	26.66	32.8	7.56
			796.6	839.3	42.66	44.74	10.97
			55	62.66	7.66	1.43	16.54
6TX03.1	1	M6	3.03	2.58	0.44	0.0561	16.5
			0.44	0.38	0.05	0.0144	15.7
6TX03.2	1	M6	3.16	3.02	0.14	0.0379	5.5
			0.15	0.13	0.02	0.0067	5
6TX03.3	1	M6	0.79	0.75	0.0338	0.0242	7.9
			0.23	0.25	0.0198	0.0141	12.4
6TX04.1	1	M6	0.83	0.69	0.14	0.01	18.07
			0.23	0.18	0.05	0.03	34.78
7IA01.1	1	M6C	4.449	4.651	0.202	0.031	5.2
			0.28	0.313	0.033	0.007	14.3
7KS02.1	1	M6	0.74	0.74	0	0.0318	4.5
			103	103	1	10.7	11.2
			95	102	7	8.49	16
			0.12	0.12	0	0.0068	9.2
8C001.1	1	M6	0.56	0.562	0.002	0.017	3.39
			0.599	0.578	0.021	0.016	6.24
			0.093	0.101	0.008	0.007	16.5

(continued)

TABLE 6. (continued)

Unit	Qtr	Method	Relative Accuracy Test Audit Values RM	CEM	Diff	CC	RA
8C002.1	1	M6	0.619	0.534	0.083	0.026	17.6
			1.08	0.098	0.01	0.002	10.7
8ND03.1	-1*	M6	0.471	0.49	0.019	0.017	7.5
8UT04.1	2	M6	0.025	0.026	-0.001	0.00168	8.6
8UT05.1	2				0.01956	0.03703	6
					0.00189	0.0083	14.9
8UT05.2	2				0.01244	0.0309	4.9
					0.00044	0.0102	15.2
9NV03.1	1	M6C	0.12	0.124	0.006	0.004	8.1

*RATA performed in November 1987.

The minimum RA is 0.9 percent and the maximum is 34.8 percent for the 53 tests. Figure 1 shows the distribution of RA values in increments of 5 percent RA. For example, the bar on the left indicates that about 18 percent of the results are between zero and five percent RA.

The inlet and outlet SO_2 CEMS measure emission rates that differ by an order of magnitude. It is not surprising, therefore, to find a different distribution of RA data for inlet and outlet monitors. Figures 2 and 3 show these distributions.

In the early 1980's, the EPA conducted a series of RATAs on CEMS subject to Subpart D NSPS. The results of these audits are available in EPA-340/1-83-012.[2] The distribution of RA results from these audits is shown in Figure 4. The distribution is essentially the same as the distribution of RA results for the outlet SO_2 CEMS shown in Figure 3. It should be noted that the EPA audits were all performed by the same testing company on a relatively small number of CEMS. The results in the DARs, on the other hand, were produced by a variety of testers on a relatively large number of CEMS measuring lower emissions. This seems to indicate an improvement in CEMS performance since the distributions are the same but the number of variables that could increase the variance in the Da results is greater.

Two facilities (5MI04.1 and 6TX04.1) reported RAs exceeding 20 percent. The CEMS at the Michigan plant was on the outlet gas stream. The RATA was done on March 1 & 2, 1988. According to the contact person the boiler was taken out-of-service for repair on March 2, 1988. In this case there is, therefore, no OOC period due to CEMS inaccuracy. Except for a slight difference in dates, the same situation occured at the Texas unit.

No correlation is evident between CEMS RA and CEMS type or manufacturer.

RELATIVE ACCURACY OF NO_x CEMS

Table 7 is a compilation of data for 31 NO_x RATAs. The EPA test method is M7 for seven of the audits; M7A for two audits; and, M7E for seventeen of the audits. Three facilities did not report the EPA test method; they are the same facilities that did not report the EPA test method for SO_2. One of the two facilities that used concentration values to calculate SO_2 RA also used concentration values for the NO_x calculation.

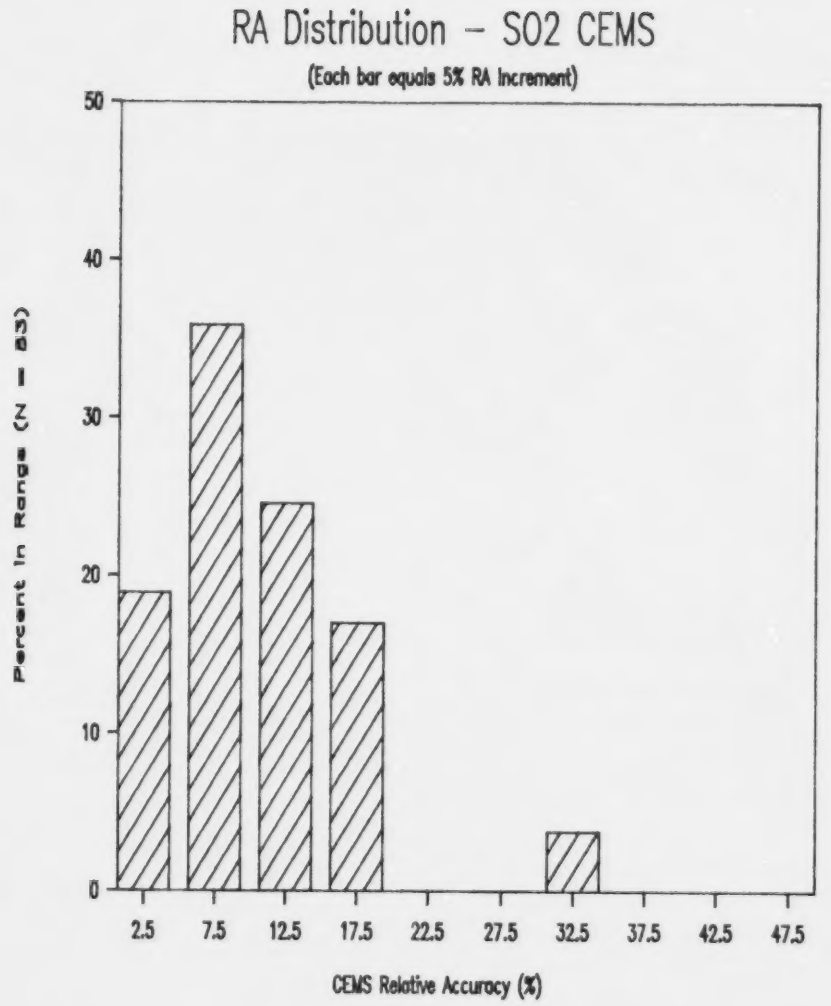

Figure 1. Distribution of Relative Accuracy Results for SO_2 CEMS.

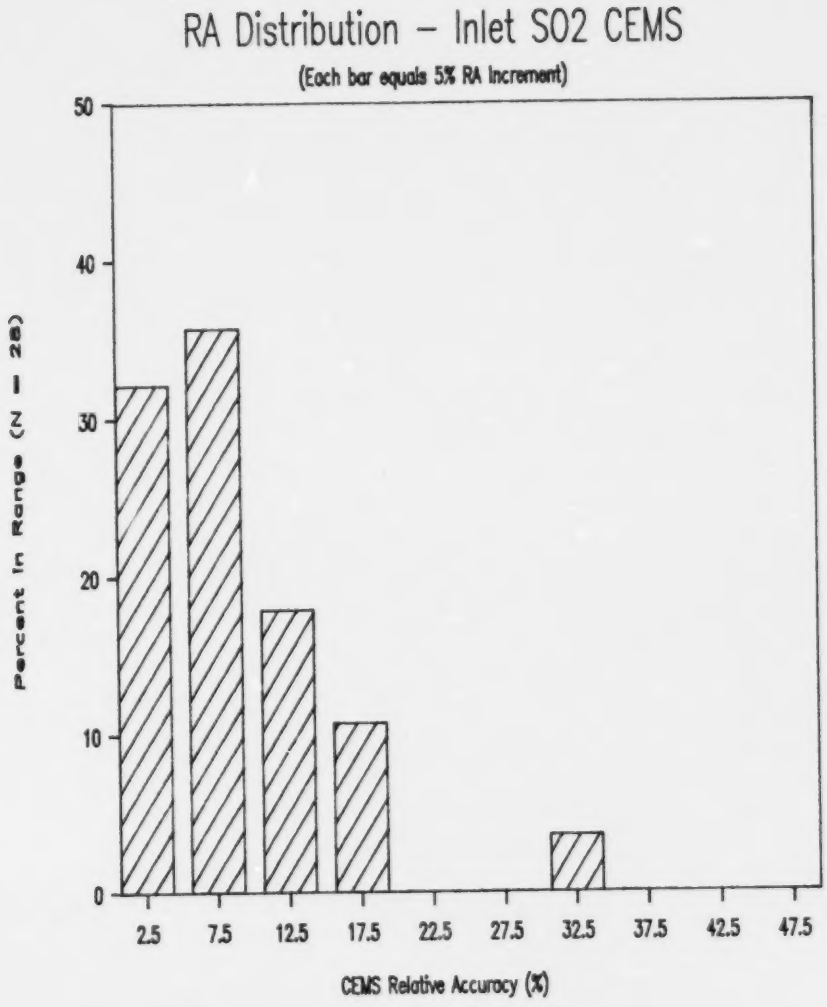

Figure 2. Distribution of Relative Accuracy Results for Inlet SO_2 CEMS.

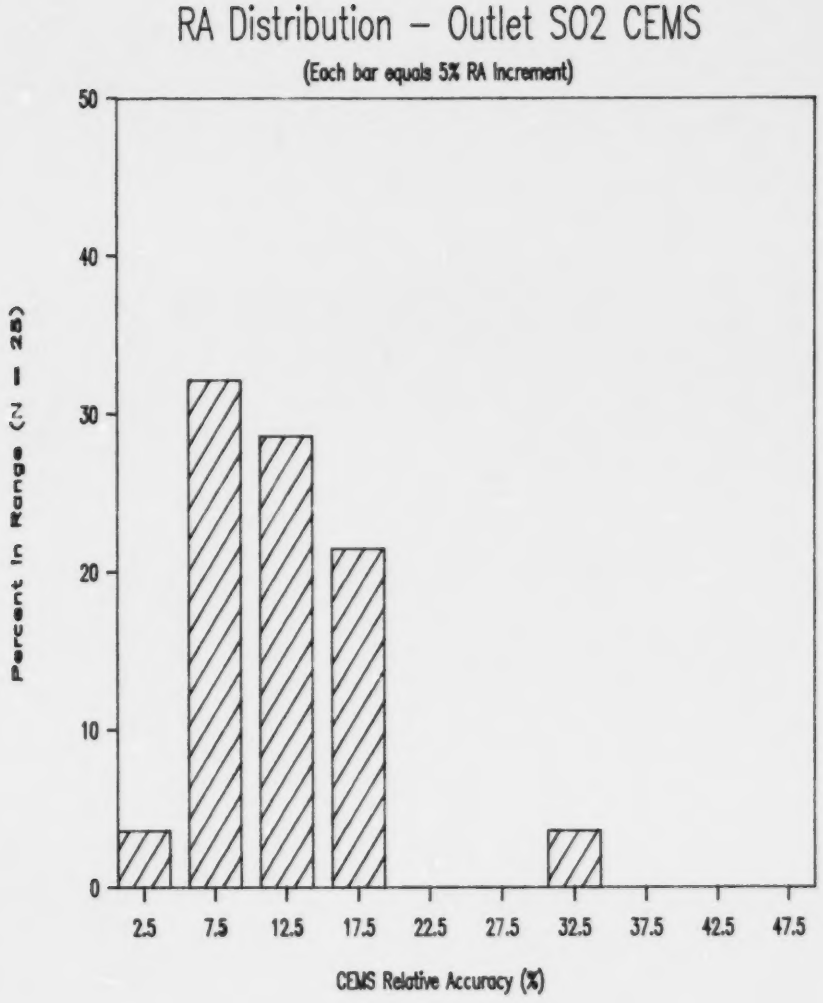

Figure 3. Distribution of Relative Accuracy Results for Outlet SO_2 CEMS.

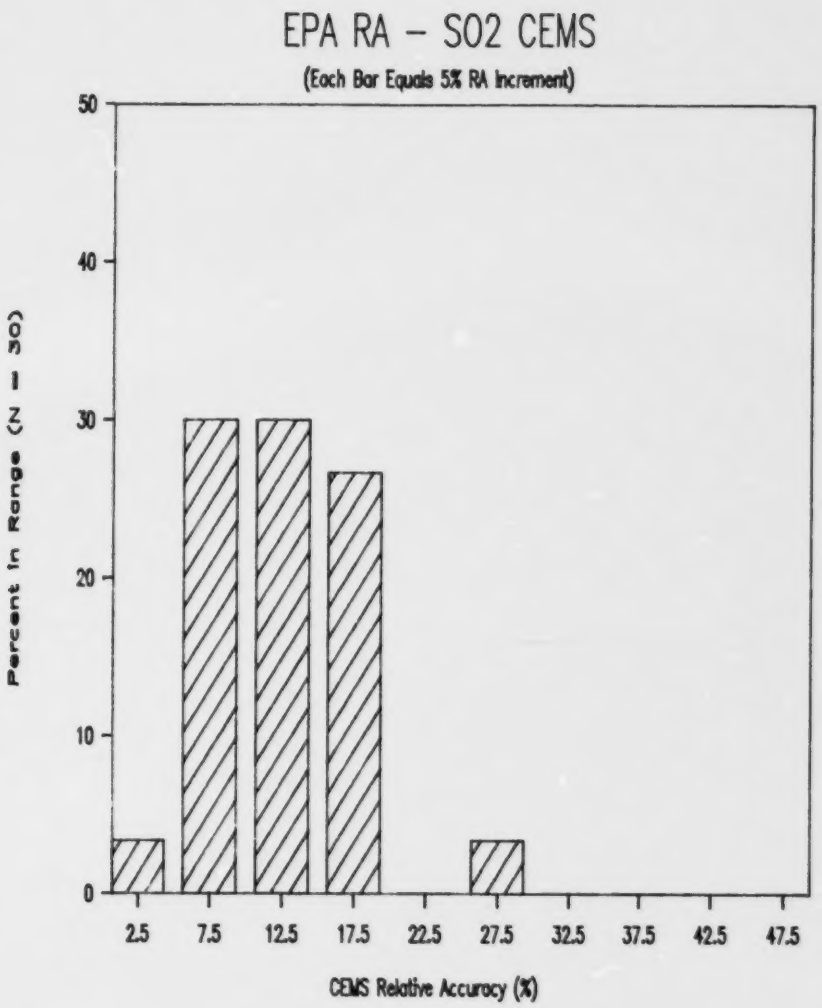

Figure 4. Distribution of Relative Accuracy Results for SO_2 CEMS in EPA Study.

Table 7. RELATIVE ACCURACY TEST AUDIT DATA FOR NOx CEMS

Unit	Qtr	Meth	Relative Accuracy Test Audit RM	CEM	Diff	CC	RA
2NY01.1	1	M7E	0.566	0.495	0.071	0.006	13.6
4FL01.1	1	M7E	0.546	0.561	0.0154	0.0082	4.3
4FL03.1	1	M7E	0.348	0.396	0.016	0.012	8.1
4FL03.2	1	M7E	0.372	0.398	0.026	0.01	9.7
4FL04.1	1	M7E	0.407	0.458	0.05	0.0018	8.6
	1	M7E	0.437	0.455	0.018	0.003	3.5
4KY05.1	1	M7E	0.458	0.396	0.062	0.012	16
4SC06.1	1	M7	0.44	0.46	0.0202	0.0142	7.74
5IN02.1	1	M7	0.5603	0.5118	0.04844	0.008289	10.12
5MI03.1	2	M7E	0.4022	0.4116	0.0094	0.0189	7.1
5MI04.1	1						30.2
6NM01.1	2	M7	205.8	210.1	13.69	6.02	9.58
6TX03.1	1	M7E	0.64	0.52	0.11	0.0151	19.6
	1	M7E	0.62	0.47	0.14	0.0101	24.8
6TX03.2	1	M7E	0.57	0.46	0.11	0.0077	20.6
	2	M7E	0.38	0.493	0.113	0.066	47.11
	2	M7E	0.458	0.467	0.009	0.01	4.15
6TX03.3	1	M7E	0.39	0.38	0.0195	0.0139	6.6
6TX04.1	1	M7E	0.48	0.32	0.16	0.01	35.42
7IA01.1	1	M7E	0.381	0.416	0.035	0.008	11.3
7KS02.1	1	M7	0.22	0.2	0.01	0.0061	8.7
8C001.1	1	M7	0.294	0.294	0.001	0.021	7.54
8C002.1	1	M7	0.217	0.252	0.035	0.011	21.2
8ND03.1	-1*	M7A	0.445	0.368	0.08	0.024	23.2
	1	M7A	0.501	0.49	0.011	0.004	2.9
8UT04.1	2	M7	0.461	0.528	-0.066	0.0413	16.1
8UT05.1	2				0.007	0.00209	2.2
	2				0.01056	0.0033	3.5
8UT05.2	2				0.0173	0.0133	8
	2				0.00578	0.00486	2.8
9NV03.1	1	M7E	0.37	0.37	0.004	0.007	3.1

*RATA performed in November 1987.

The minimum RA in Table 7 is 2.2 percent; the maximum is 47.1 percent. Figure 5 shows the distribution of RA values in increments of five percent RA. For example, the bar on the left indicates that approximately 25 percent of the RA values are in the range zero to five percent RA.

A distribution of NO_x audit results for Subpart D facilities reported in EPA-340/1-83-012 is shown in Figure 6. A comparison of this distribution with the distribution shown in Figure 5 shows a higher percentage of Da NO_x CEMS with RAs less than 10 percent. This appears to represent a real improvement in CEMS performance, considering that the Da results were probably influenced by more variables than the EPA study results.

Six facilities reported NO_x RA in excess of 20 percent:

5MI04.1 - See explanation for SO_2 RATA.

6TX03.1 - The 24.8 percent RA was measured on January 22, 1988; the 19.6 percent value was measured on January 29, 1988. Information obtained for this study does not indicate if the CEMS was defined as OOC between the two audits. Since the DAR information was apparently transmitted as pages 87 thru 91 of a more extensive report, it is certainly possible that the more extensive report contains a clarifying discussion of this situation.

6TX03.2 - The 20.6 percent RA was measured on January 28, 1988. The 47.1 percent RA was measured on April 4 thru 6, 1988, after a boiler outage; the 4.2 percent RA was measured on April 13, 1988. No explanation was provided with the data obtained for this study, although it may be available to the enforcement agency.

6TX04.1 - See explanation for the SO_2 RATA.

8C002.1 - A note in the DAR explains the high RA as the result of "reference method testing problems."

8ND03.1 - The 23.2 percent RA was measured in November, 1987; the 2.9 percent RA was classified as a repeat test, and was done in February, 1988. Since the first test preceeded the effective date of Appendix F, the designation of an OOC period was not necessary.

No correlation is evident between NO_x RA and CEMS type or manufacturer.

RATA CONFIDENCE COEFFICIENT

The measurements made during a RATA are summarized in two parameters, which are combined in the CEMS RA. One of these parameters is the absolute difference between the mean of the emissions measurements and the mean of the CEMS response. This parameter represents CEMS bias. The other parameter is a statistical

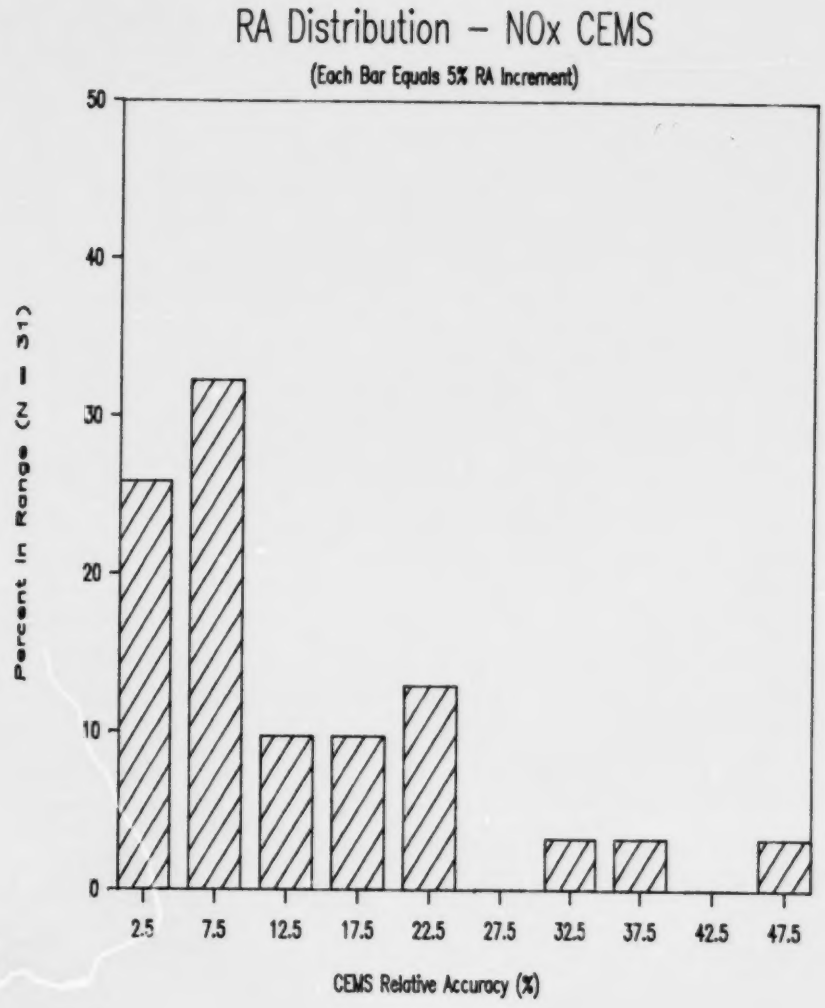

Figure 5. Distribution of Relative Accuracy Results for NO_x CEMS.

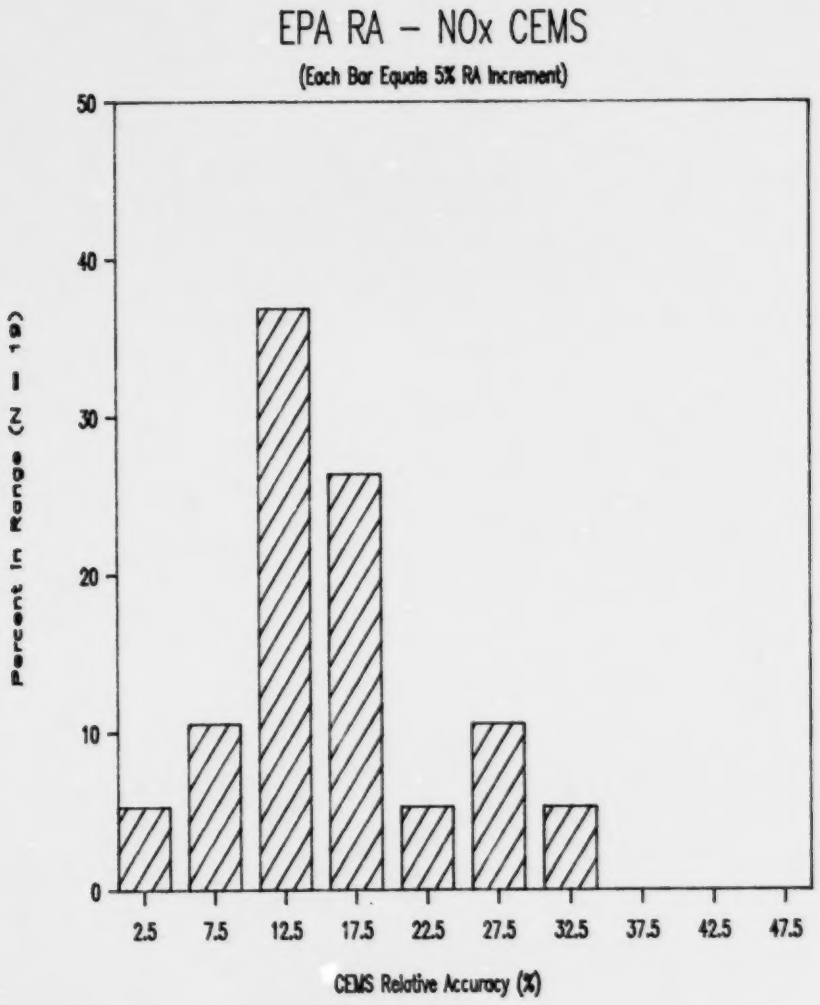

Figure 6. Distribution of Relative Accuracy Results for NO_x CEMS in EPA Study.

estimate of CEMS precision, calculated as the 2.5 percent error confidence coefficient.

An hypothesis is that the RA of a CEMS is greater when manual test methods are used for the RATA, compared to when instrumental methods are used for the audit, because of inherent imprecision in the manual methods. Data for the SO_2 RATAs tend to support this hypothesis.

Reported confidence coefficients were recalculated as a fractional percent of the CEMS RA. Results for the SO_2 CEMS are shown in Figure 7. In Figure 7 the confidence coefficient, as a percent of RA, is shown as a function of RA. The data do not show a correlation with RA, but it can be seen that the confidence coefficients for RATAs using the instrumental Method 6C tend to be less than about 55 percent of RA. Confidence coefficients for RATAs using the manual Method 6, on the other hand, are frequently more than 60 percent of RA. Results for NO_x CEMS are summarized in Figure 8. No trend is seen in this case, which may be because of the limited number of data points with the manual Method 7.

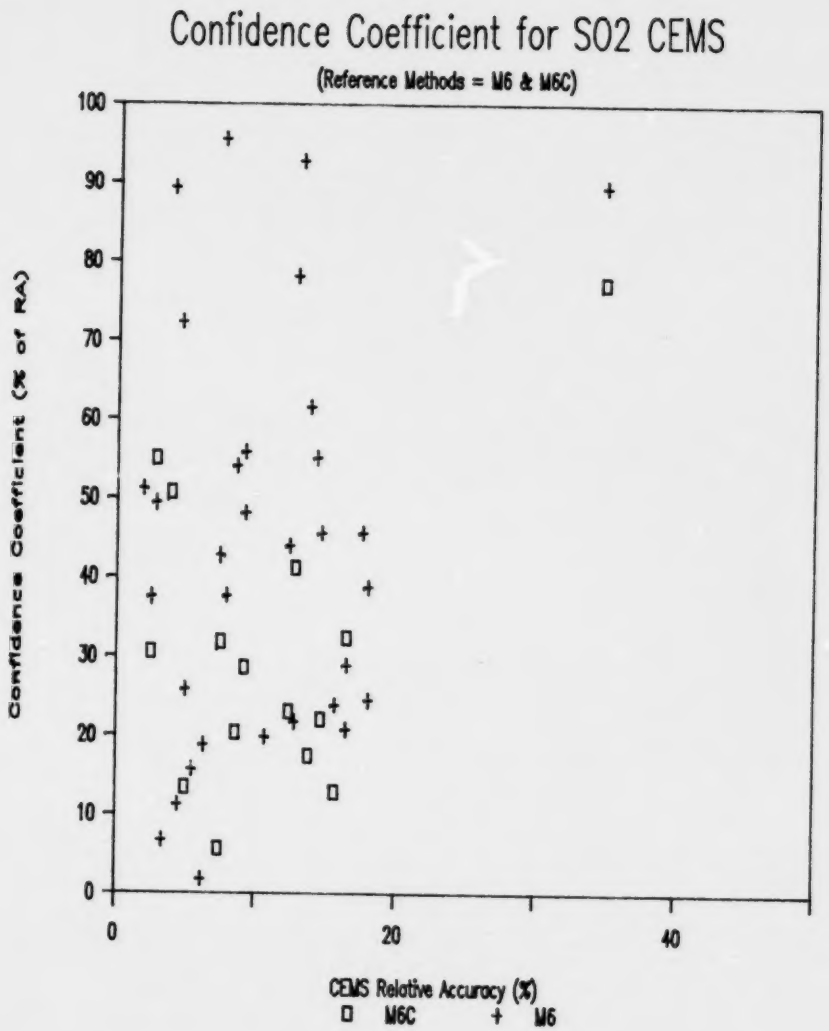

Figure 7. Fraction of SO_2 CEMS Relative Accuracy Attributed to Confidence Coefficient

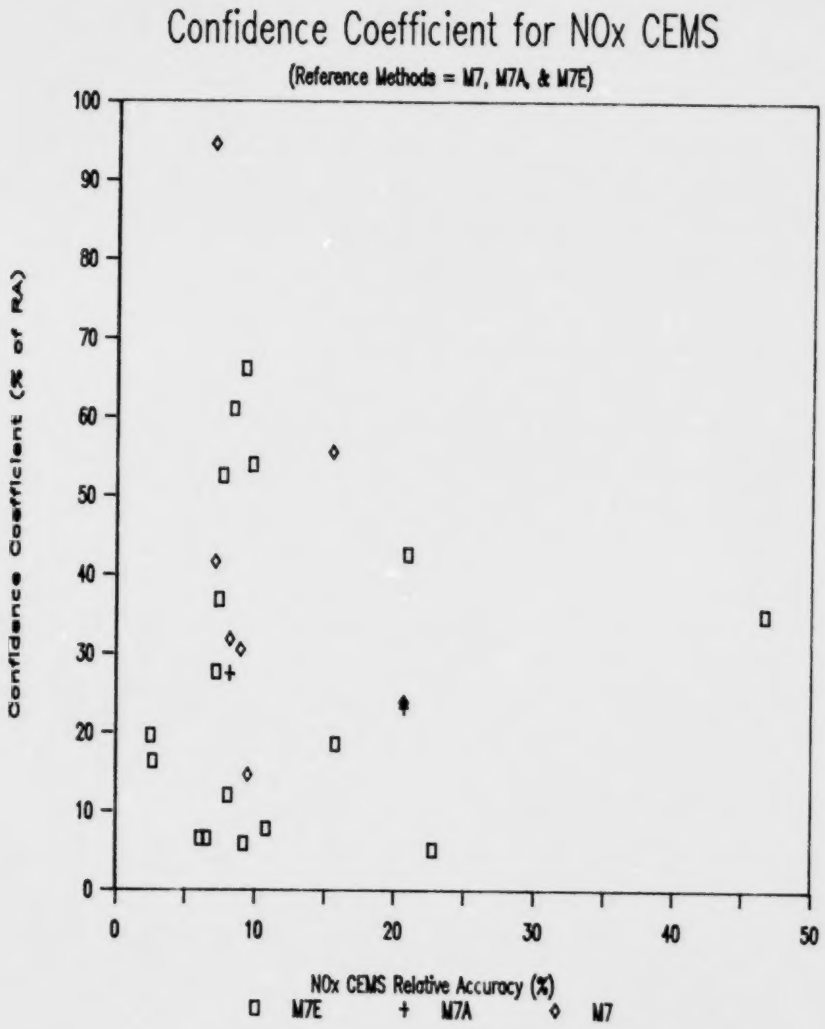

Figure 8. Fraction of NO_x CEMS Relative Accuracy Attributed to Confidence Coefficient.

SECTION 5

CYLINDER GAS AUDITS

GENERAL INFORMATION

Appendix F allows the source owner to do three CGAs each calendar year. A CGA is a check of the CEMS response to cylinder gases of known concentration. The cylinder gas is supposed to be injected at the CEMS sampling nozzle. Instrument response is compared to cylinder gas concentrations at two prescribed levels. The result is called CGA Accuracy. CGA Accuracy is the difference between the CEMS response and the audit gas concentration, and is expressed as a percent of the audit gas concentration. Under this definition, negative accuracy means that the CEMS is reading low relative to the audit gas concentration. If the difference is more than 15 percent the CEMS is defined as OOC; data collected after the audit is done and before the inaccuracy is demonstrated to be corrected cannot be used to meet the minimum data requirements of Subpart Da.

Data on CGAs were obtained for 21 Da facilities. The data are listed in Table 8. The last two columns in Table 8 show accuracy values: (1) as reported in the DARs; and, (2) as recalculated for this report. The values were recalculated to verify the reported values and to check positive and negative results. A review of Table 8 shows:

- One facility (5IN01.2) reported an inaccuracy slightly in excess of 15 percent for an outlet SO_2 analyzer. The DAR lists the value as 15 percent and does not include any reference to an OOC period.
- Five facilities reported a positive value for CGA Accuracy when the accuracy was a negative value.
- One facility did not report the CEMS response to the audit gas.

DISTRIBUTION OF CGA ACCURACY VALUES

Figures 9 through 12 show the distribution of CGA Accuracy values for outlet SO_2, NO_x, CO_2, and O_2. Each bar equals an increment of 6 percent Accuracy. For example, the bar plotted at 0 percent represents the fraction of CGA values between -3 and +3 percent. The number of data points used to generate the distribution is shown as "N" in the label for the vertical scale of each figure.

TABLE 8. CYLINDER GAS AUDIT INFORMATION

Unit	Qtr	I/O	Gas*	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR			(2) Recalculated Values			
2NY01.1	2	I	SO2	749	813.4	8.6	8.60
		I	SO2	749	766.5	2.3	2.34
		I	SO2	1640	1637.2	-0.2	-0.17
		I	SO2	1640	1679.5	2.4	2.41
		0	SO2	816	820.2	0.5	0.51
		0	SO2	325	334	2.8	2.77
	2	I	02	6.266	6.146	-1.9	-1.92
	2	I	02	13.02	13.176	1.2	1.20
		I	02	6.266	6.533	4.3	4.26
		0	02	13.02	12.734	-2.2	-2.20
		0	02	6.266	6.206	-1	-0.96
		0	NOx	330.1	348.4	5.5	5.54
		0	NOx	813.8	810.7	-0.4	-0.38
4FL01.1	2	I	SO2	2013		3	3.00
		I	SO2	900.2		2.5	2.50
		0	SO2	89.39		-4.5	-4.50
		0	SO2	200.2		-6.4	-6.40
		I	02	9.089		3.4	3.42
		I	02	3.924		1.9	1.94
		0	02	3.924		1.9	1.94
		0	02	9.089		2.3	2.32
		0	NOx	259.1		2	2.00
		0	NOx	556.8		2.6	2.60
4FL03.1	2	I	SO2	780	787	0.9	0.90
		I	SO2	1656	1659	0.18	0.18
		I	SO2	1656	1668	0.72	0.72
		I	SO2	780	776	-0.51	-0.51
		0	SO2	410	384	-6.34	-6.34
		0	SO2	187	175	-6.4	-6.42
		I	02	5	5.02	0.4	0.40
		I	02	10	9.99	-0.1	-0.10
		I	02	5	5.05	1	1.00
		I	02	10	10.03	0.3	0.30
		0	02	10	10.09	0.9	0.90
		0	02	5	5.02	0.4	0.40
		0	NOx	400	419	4.75	4.75
		0	NOx	174	180	3.45	3.45

(Continued)

TABLE 8. (continued)

Unit	Qtr	I/O*	Gas	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR				(2) Recalculated Values		
4FL03.2	2	I	SO2	780	784	0.51	0.51
		I	SO2	780	769	-1.41	-1.41
		I	SO2	1656	1654	-0.12	-0.12
		I	SO2	1656	1634	-1.33	-1.33
		0	SO2	410	397	-3.17	-3.17
		0	SO2	187	174	-6.95	-6.95
		I	O2	10	10.01	0.1	0.10
		I	O2	10	10.04	0.4	0.40
		I	O2	5	5.01	0.2	0.20
		I	O2	5	5.01	0.2	0.20
		0	O2	10	10.06	0.6	0.60
		0	O2	5	5	0	0.00
		0	NOx	400	387	-3.25	-3.25
		0	NOx	174	171	1.72	-1.72
4FL04.1	2	I	SO2	899.5	916	1.8	1.83
		I	SO2	2009	2017	0.4	0.40
		0	SO2	197.4	189.6	-4	-3.95
		0	SO2	83.99	78.9	-6.1	-6.06
		I	O2	4.999	5	0	0.02
		I	O2	8.974	8.99	0.2	0.18
		0	O2	8.974	9	0.3	0.29
		0	O2	4.999	5.033	0.7	0.68
		I	NOx	248.4	247.8	-0.2	-0.24
		I	NOx	98.63	92.4	-6.3	-6.32
		0	NOx	199.5	191.2	-4.2	-4.16
		0	NOx	98.63	98.67	0	0.04
4SC06.1	2	I	SO2	221	227.26	2.83	2.83
		I	SO2	100	100.35	0.35	0.35
		I/O	O2	4.99	5.03	0.87	0.80
		I/O	O2	10	10.07	0.7	0.70
		0	NOx	539	541.34	0.43	0.43
		0	NOx	252	248.52	-1.38	-1.38
5IN01.1	1	I	SO2	2192	2307	5	5.25
		I	SO2	1185	1233	4	4.05
		0	SO2	118	107	10	-9.32
		0	SO2	214	193	10	-9.81
		I	O2	5	5.1	2	2.00
		I	O2	12	12.2	2	1.67
		0	O2	12	12.3	3	2.50
		0	O2	5	5	0	0.00
		0	NOx	253	240	5	-5.14
		0	NOx	490	473	4	-3.47

(Continued)

TABLE 8. (continued)

Unit	Qtr	I/O*	Gas	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR				(2) Recalculated Values		
5IN01.2	1	I	SO2	1185	1210	2	2.11
		I	SO2	2192	2203	1	0.50
		O	SO2	214	188	12	-12.15
		O	SO2	118	100	15	-15.25
		I	O2	5	5.3	6	6.00
		I	O2	12	11.9	1	-0.83
		O	O2	12	12.1	1	0.83
		O	O2	5	5.1	2	2.00
		O	NOx	253	240	5	-5.14
		O	NOx	490	472	4	-3.67
5MN06.1	1	I	SO2	303	315.93	4.3	4.27
		I	SO2	817	798.27	2.3	-2.29
		I	SO2	1285	1212.13	5.7	-5.67
		O	SO2	639	620.77	2.9	-2.85
		O	SO2	425	414.9	2.4	-2.38
		O	SO2	146.8	154	4.9	4.90
		I	O2	1.02	1	2	-1.96
		I	O2	20.9	21	0.5	0.48
		O	NO	425	433.17	1.9	1.92
		O	NO	145.5	154.73	6.3	6.34
		O	NO	639	617.43	3.4	-3.38
		O	CO2	12	11.8	1.7	-1.67
		O	CO2	9.02	8.9	1.3	-1.33
		O	CO2	6.11	6.1	0.2	-0.16
5MN06.1	2	I	SO2	830	835.97	0.7	0.72
		I	SO2	1285	1269.87	1.2	-1.18
		I	SO2	297	318.87	7.4	7.36
		O	SO2	148	148.4	0.3	0.27
		O	SO2	655	625	4.6	-4.58
		O	SO2	421	399.6	5.1	-5.08
		I	O2	4	3.98	1	-0.50
		I	O2	7.8	7.57	3.7	-2.95
		O	NO	654	615.67	5.9	-5.86
		O	NO	148	152.2	2.8	2.84
		O	NO	421	432.53	2.7	2.74
		O	CO2	11.9	11.83	0.6	-0.59
		O	CO2	18.1	17.87	1.3	-1.27
		O	CO2	3.9	4.1	2.8	5.13

(Continued)

TABLE 8. (continued)

Unit	Qtr	I/O*	Gas	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR				(2) Recalculated Values		
6TX03.1	2	I	SO2	942.8	947.7	0.5	0.52
		I	SO2	942.8	947	0.4	0.45
		O	SO2	122.7	120	-2.2	-2.20
		O	NOx	248.7	252	1.3	1.33
		I	CO2	6	5.6	-6.7	-6.67
		I	CO2	6	6.6	0	10.00
			CO2	6	6	0.6	0.00
6TX03.2	2	I	SO2	942.8	821.7	-12.8	-12.84
		I	SO2	2575	2653.7	3.1	3.06
		I	SO2	942.8	821.7	-12.8	-12.84
		I	SO2	2575	2644.7	2.7	2.71
		O	SO2	122.7	122.7	0.1	0.00
		O	NOx	248.7	251	0.9	0.92
		O	NOx	549.1	555.7	1	1.20
		I	CO2	12.4	12.7	2.4	2.42
		I	CO2	6	6.1	1.7	1.67
		I	CO2	6	6.1	1.7	1.67
		I	CO2	12.4	12.7	2.4	2.42
		O	CO2	12.4	12.7	2.4	2.42
		O	CO2	6	6.2	3.3	3.33
6TX03.3	2	I	SO2	942.8	945.9	0.3	0.33
		I	SO2	285.8	272	-4.8	-4.83
		O	SO2	285.8	274	-4.1	-4.13
		O	SO2	122.7	126.2	2.9	2.85
		O	NOx	248.7	232.7	-6.4	-6.43
		O	NOx	549.1	505.8	-7.9	-7.89
		O	CO2	6	5.3	-11.7	-11.67
		O	CO2	12.4	12.6	1.6	1.61
7IA01.1	2	I	SO2	990	1096.7	10.8	10.78
		I	SO2	1966	2158.6	9.8	9.80
		O	SO2	141	146.5	4	3.90
		O	SO2	260	265.9	2.3	2.27
		I	O2	5.38	5.1	-5.2	-5.20
		I	O2	10.1	10.1	0	0.00
		O	O2	5.17	4.9	-5.2	-5.22
		O	O2	10.2	10.5	2.9	2.94
		O	NOx	565	558.1	-1.2	-1.22
		O	NOx	248	240.2	-3.1	-3.15

(Continued)

TABLE 8. (continued)

Unit	Qtr	I/O*	Gas	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR				(2) Recalculated Values		
7KS02.1	2	I	SO2	200.3	183.93	-8.17	-8.17
		I	SO2	400.5	409.72	2.3	2.30
		O	SO2	61.45	61.97	0.85	0.85
		O	SO2	200.3	214.77	7.22	7.22
		O	SO2	136.9	139.06	1.58	1.58
		O	SO2	91.01	93.94	3.22	3.22
		O	SO2	91.01	90.09	-1.01	-1.01
		O	SO2	200.3	200.63	0.17	0.16
		O	SO2	136.9	138.8	1.39	1.39
		O	SO2	279.7	282.1	0.86	0.86
		I	02	5.02	5.11	1.83	1.79
		I	02	8.96	9.15	2.11	2.12
		O	02	8.96	9.58	6.88	6.92
		O	02	5.02	5.12	2.02	1.99
		O	02	8.96	9.54	6.37	6.47
		O	02	5.02	5.11	1.92	1.79
		O	NOx	562.2	567.66	0.97	0.97
		O	NOx	252.9	256.03	1.23	1.23
8C001.1	2	I	SO2	247.3	232.7	6.3	-5.90
		I	SO2	543.9	567.3	4.1	4.30
		I	SO2	247.3	253.7	2.5	2.59
		I	SO2	543.9	529	2.8	-2.74
		O	SO2	125.5	132.5	5.2	5.58
		O	SO2	50.4	52.6	4.2	4.37
		O	NO	274.8	285.3	3.7	3.82
		O	NO	512.1	519.1	1.3	1.37
		I	CO2	6.8	6.6	2.5	-2.94
		I	CO2	6.8	6.7	1.5	-1.47
		I	CO2	10	10.5	4.8	5.00
		I	CO2	10	10.3	2.9	3.00
		O	CO2	6.9	6.8	1.5	-1.45
		O	CO2	10	10.7	6.5	7.00
8C002.1	1	I	SO2	199.5	195.7	-1.29	-1.90
		I	SO2	152.7	150.73	-1.9	-1.29
		I	SO2	70.4	77.3	9.8	9.80
		O	SO2	70.4	68.8	-2.27	-2.27
		O	SO2	199.5	199.5	-4.11	0.00
		O	SO2	146.7	142.8	-2.66	-2.66
		O	NO	237	235.27	-0.73	-0.73
		O	NO	69.8	68.23	-2.25	-2.25
		O	NO	169.4	169.37	-0.02	-0.02
		I	CO2	6.45	5.97	-7.44	-7.44
		I	CO2	14.94	14.5	-2.95	-2.95
		I	CO2	11.41	10.97	-3.86	-3.86
		O	CO2	14.94	14.8	-0.94	-0.94
		O	CO2	6.45	6.23	-3.41	-3.41
		O	CO2	11.44	11.23	-1.84	-1.84

(Continued)

TABLE 8. (continued)

Unit	Qtr	I/O*	Gas	Concentration Audit	Concentration CEMS	% Accuracy (1)	% Accuracy (2)
	(1) As Reported in DAR				(2) Recalculated Values		
8CO02.1	2	I	SO2	199.5	204.7	2.61	2.61
		I	SO2	311	317.6	2.12	2.12
		I	SO2	70.4	77.98	10.77	10.77
		I	SO2	70.4	71.68	1.82	1.82
		I	SO2	311	303.72	-2.34	-2.34
		I	SO2	199.5	191.2	-4.16	-4.16
		O	SO2	152.7	150.85	-1.21	-1.21
		O	SO2	70.4	71.09	0.98	0.98
		O	SO2	199.5	194.47	-2.52	-2.52
		O	NO	171.6	176.07	2.6	2.60
		O	NO	69.8	71.06	1.81	1.81
		O	NO	237	240.82	1.61	1.61
		I	CO2	6.45	6.43	-0.31	-0.31
		I	CO2	11.55	11.67	1.04	1.04
		I	CO2	14.94	15.15	1.41	1.41
		I	CO2	14.94	15.64	4.69	4.69
		I	CO2	6.45	6.63	2.79	2.79
		I	CO2	11.55	11.99	3.81	3.81
		O	CO2	6.45	6.25	-3.1	-3.10
		O	CO2	14.94	14.82	-0.8	-0.80
		O	CO2	11.41	11.33	-0.7	-0.70
8ND03.1	2	O	SO2	346.6	378.3	9.15	9.15
		O	SO2	796.5	804.3	0.97	0.97
		O	02	4.975	5	0.5	0.50
		O	02	10.01	9.96	-0.5	-0.50
		O	NOx	260.4	270.3	3.8	3.80
		O	NOx	543.7	572.3	5.25	5.25
8UT04.1	1	O	SO2	35	31.3	-10.6	-10.57
		O	SO2	76	74	-2.6	-2.63
		O	02	9.6	9.5	-1	-1.04
		O	02	5	4.8	-4	-4.00
		O	NOx	258	268	3.9	3.88
		O	NOx	566	597	5.5	5.48
8UT05.2	1	O	SO2	29.5	32	8.5	8.47
		O	SO2	271	290	7	7.01
		O	SO2	55.3	58.6	6	5.97
		O	SO2	578	596	3.1	3.11
		O	02	5.36	5.4	0.8	0.75
		O	02	10.24	10.1	-1.4	-1.37
		O	NOx	578	571	-1.2	-1.21
		O	NOx	263	267	1.5	1.52

*I = Inlet, O = Outlet

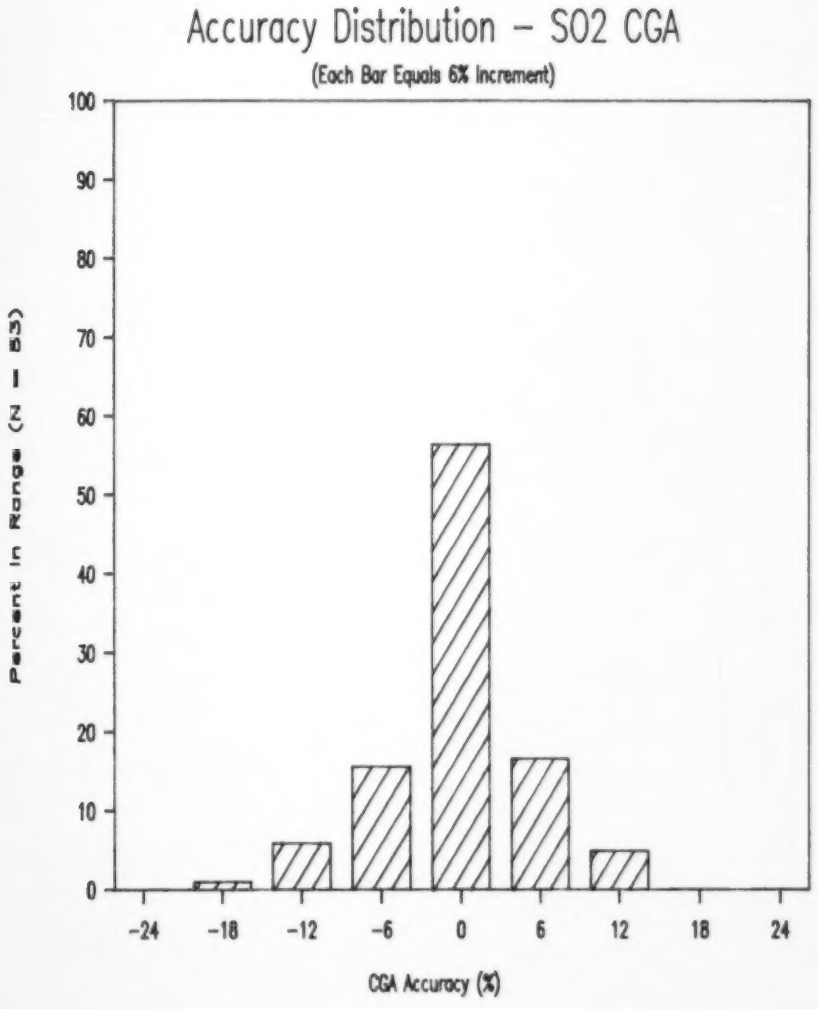

Figure 9. Distribution of CGA Accuracy Results for Outlet SO_2 Analyzers.

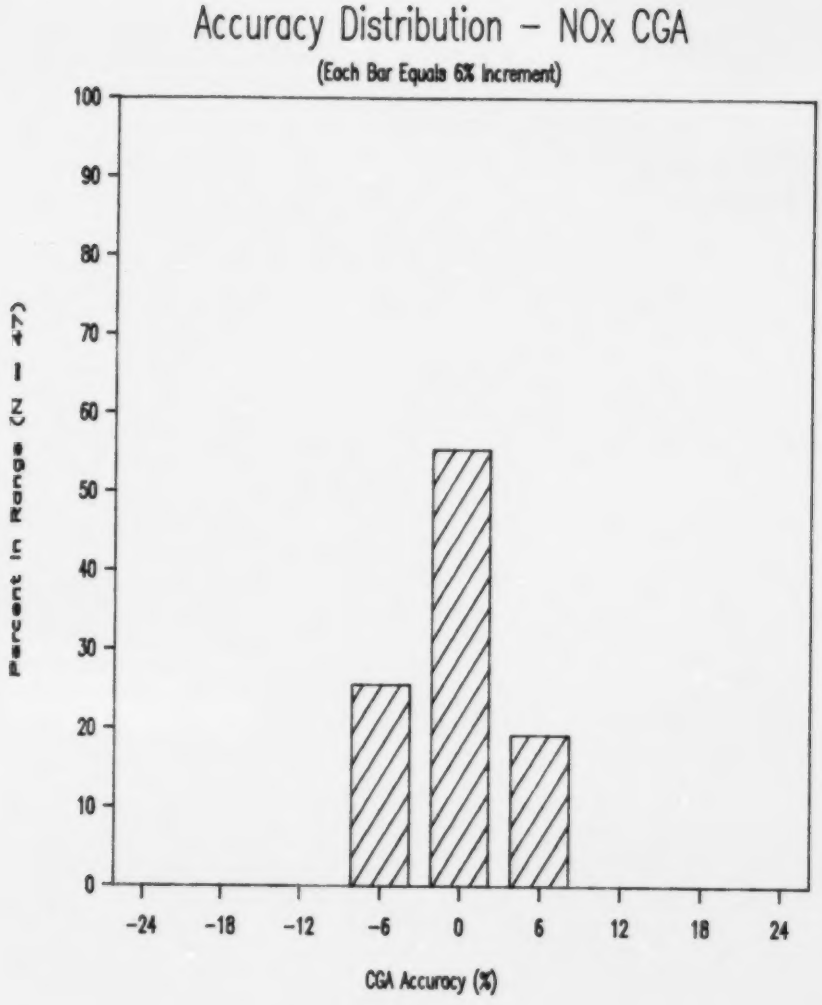

Figure 10. Distribution of CGA Accuracy Results for NO_x Analyzers.

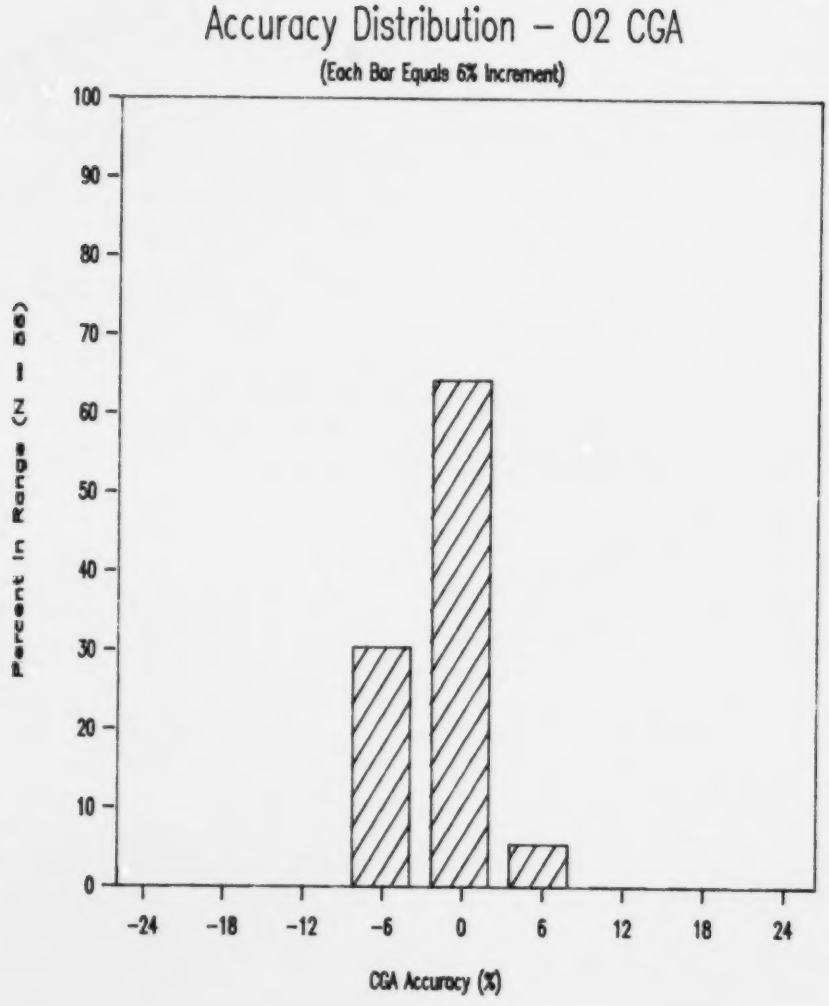

Figure 11. Distribution of CGA Accuracy Results for O_2 Analyzers.

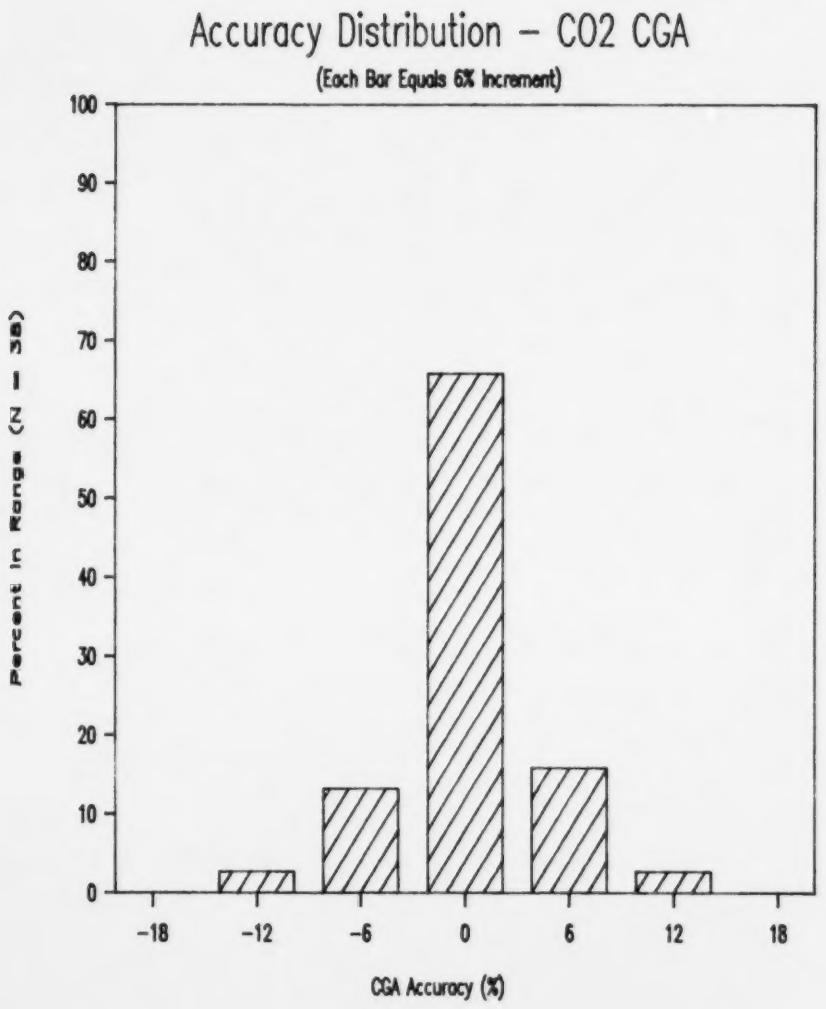

Figure 12. Distribution of CGA Accuracy Results for CO_2 Analyzers.

Except for O_2, the values appear to be distributed normally around a central value of zero percent. The O_2 data indicate a distribution that is skewed in the negative direction.

The data for the inlet and outlet SO_2 monitors appear to have slightly different distributions, with the data for the outlet monitors showing a greater range from maximum to minimum values. There is insufficient data to warrant further analysis of this possibility, although it is consistent with the RATA results.

CORRELATION OF CGA ACCURACY WITH OTHER PARAMETERS

No correlation is evident between the results of the CGAs and other parameters such as CEMS type, manufacturer, or reported OOC periods.

SECTION 6
RELATIVE ACCURACY AUDITS

Appendix F includes a provision for conducting an audit of those CEMS that cannot be checked with a CGA. The techinque is called a Relative Accuracy Audit (RAA). It is based on a comparison of CEMS response response with EPA reference method measurements. For the RAA, the average of three measurements are compared directly and reported as a percent Accuracy, comparable to the results of the CGA.

Data on a RAA were submitted by two facilities (4KY05.1 and 4SC06.1). The Kentucky facility did the RAA for the SO_2 and NO_x CEMS. The RAA at the South Carolina facility was done for a back-up SO_2 analyzer.

Table 9 is a summary of the RAA information obtained for this study. Monitor accuracy ranges from -3 to +6 percent.

TABLE 9. RELATIVE ACCURACY AUDIT DATA

Unit	Qtr	I/O*	Gas	Method	RAA Values RM	RAA Values CEM	% A
4KY05.1	2	I	SO2	M6C	7.105	7.534	6
		I	SO2	M6C	7.076	6.806	-4
		O	SO2	M6C	0.547	0.54	-1
		O	NOx	M7E	0.388	0.376	-3
4SC06.1	2	I	SO2	M6	1.788	1.855	3.8

*I = Inlet; O = Outlet

SECTION 7

CALIBRATION DRIFT ASSESSMENT

GENERAL INFORMATION

Section 60.13 of the NSPS General Provisions requires a daily assessment of drift and corrective action if the drift exceeds two times the applicable specification in 40 CFR Part 60 Appendix B. For SO_2 and NO_x the applicable specification is 2.5 percent of span; for O_2 and CO_2 it is 0.5 percent from the reference value. Appendix F reiterates the requirement for a daily assessment of drift and defines the procedure as a Calibration Drift Assessment (CDA). Appendix F also defines the CEMS as OOC if the CDA shows that drift exceeds:

- Two times the allowable Appendix B specification for five consecutive days; or,
- Four times the allowable Appendix B specification in a single day.

Copies of DARs with information on CDA were obtained for 15 facilities. The facilities are listed in Table 10, along with a notation indicating which analyzers were identified as having excessive calibration drift (CD). Ten of the 15 facilities listed in Table 10 defined at least one OOC period during the first and second quarters of 1988. Seven of the facilities listed an OOC period for more than one analyzer.

DURATION OF OOC PERIODS DUE TO EXCESSIVE CD

By definition, CD can only be determined after a days operation of the CEMS without manual adjustment. In addition, an OOC period due to excessive CD is defined as the period starting with the day the excessive CD is detected and ending with the day on which no excessive CD is demonstrated. Therefore, the minimum duration of an OOC period due to excessive CD is one day.

The purpose of defining an OOC period under Appendix F is to identify periods when the data generated by a CEMS cannot be used to satisfy the minimum data requirements of Subpart Da. An OOC period for one analyzer is, therefore, the same as an OOC period for the CEMS.

Three facilities (4FL04.1, 8ND03.1, and 9NV03.1) reported OOC periods in days. One of these facilities reported OOC periods for each analyzer. In this case it would be difficult for an agency person to relate the OOC periods to Da

TABLE 10. SUMMARY OF OOC PERIODS RESULTING FROM CDA BY Da FACILITY AND ANALYZER

Facility	First Quarter DAR				Second Quarter DAR			
	SO2	NOx	O2	CO2	SO2	NOx	O2	CO2
2NY01.1	N	N	N	NA	N	N	N	NA
4FL01.1	Y	Y	Y	NA	Y	N	N	NA
4FL03.1	Y	Y	Y	NA	N	N	N	NA
4FL03.2	Y	N	Y	NA	N	N	Y	NA
4FL04.1	N	N	Y	NA	NR	NR	NR	NA
4KY05.1	N	N	NA	N	N	N	NA	N
6NM01.1					Y	Y	Y	NA
6TX03.1	Y	Y	NA	N				
6TX03.2	Y	Y	NA	Y				
7IA01.1	N	N	N	NA	Y	Y	Y	NA
7KS02.1					N	N	N	NA
8C001.1	N	N	NA	N	N	N	NA	N
8C002.1	N	N	NA	N	NR	NR	NA	NR
8ND03.1	NR	NR	NR	NA	Y	Y	Y	NA
9NV03.1	Y	N	N	NA				

N = No OOC periods during quarter.
Y = OOC period during quarter.
NA = Not Applicable - gas not monitored.
NR = Information on OOC not reported.

minimum data requirements, because of multiple, overlapping exceedances for several analyzers in the same CEMS.

Twelve facilities reported the date and time of day for the start and end of OOC periods. For many of the entries the end of the OOC period generally appears to be the time when the analyzer was recalibrated after corrective action. In other cases the OOC periods appear to be the time an analyzer was off-line for periodic maintenance or recalibration.

CORRECTIVE ACTIONS

Table 11 is a listing of corrective actions as noted in the DARs. The number shown to the right of each item is the number of times the specific item is mentioned. The two items mentioned the most are manual calibration and resetting of the automatic drift compensator. Replacement of analyzer lamps and calibration gas are the next most frequent corrective actions. More than 60 percent of the corrective actions are in the category of Periodic Maintenance Calibration.

TABLE 11. CORRECTIVE ACTIONS IN RESPONSE TO EXCESSIVE CALIBRATION DRIFT

CORRECTIVE ACTION	NUMBER
Periodic Maintenance or Calibration	(40)
Manual Calibration	14
Reset Automatic Drift Compensator	6
Replace Condenser Traps	1
Replace Analyzer Lamp	5
Clean Analyzer Cell	1
Clean Probe	1
Replace Filter	2
Adjust Calibration Gas Pressure	1
Replace Calibration Gas	5
Clean Oxygen Analyzer Furnace	1
Repair Leaks	1
Preventative Maintenance	2
Analyzer Repair	(12)
Replace Radiation Rejection Filter	1
Replace Analyzer Cell	2
Replace Resistance Temperature Detector	2
Replace NOx Converter	1
Replace Capillaries	1
Adjust Lamp Current	1
Replace Thermal Fuse	3
Replace Diaphragm in Valve	1
Repair Calibration Gas System	(3)
Replace Calibration Gas Regulator	1
Replace Calibration Gas Check Valve	2
Other Corrective Actions	(10)
Replace Electronic Board in Computer	1
Replace Interface Chip in Computer	1
Repair Damaged Cable	1
Repair Switchgear	1
Replace Vacuum Pump	1
Replace Relay	2
Repair Air Conditioner for CEMS Cabinet	3
Number of Items Listed	29
Number of Corrective Actions	65

SECTION 8

FORMAT OF THE DATA ASSESSMENT REPORTS

Appendix F includes an example format for a DAR. Except for a few cases, the example or slight modifications of the example was followed. In those cases where the example format was not followed the audit results appear to be included as portions of more comprehensive quarterly reports.

SECTION 9

REFERENCES

1. Peeler, J. W., Identification of Subpart Da Sources and EPA Regional/State Agency Contacts for the Implementation of Appendix F, Procedure 1, EPA-600/4-88-015, March 1988.

2. Peeler, J. W., Compilation of SO_2 and NO_x Continuous Emission Monitoring Reliability Information, EPA-340/1-83-012, January 1983.